Illinois Department of Transportation
2300 South Dirksen Parkway / Springfield, Illinois/62764

June 26, 1992

National Bridge Inspection Standards(NBIS) #92-11
Scour Critical Bridge Evaluation
Local Agency Bridge Design

COUNTY ENGINEERS/SUPERINTENDENT OF HIGHWAYS
MUNICIPAL ENGINEERS
CONSULTING ENGINEERS

All bridges over waterways must be designed or evaluated in accordance with FHWA Technical Advisory, "Evaluating Scour at Bridges", October 28,1991 (copy attached) and Hydraulic Engineering Circular 18 (HEC 18). This letter supplements Letter #91-8 which contained scour screening guidelines. Attached to this letter is the new departmental policy for local bridges regarding scour, entitled "SCOUR CRITICAL EVALUATION FOR LOCAL ROAD BRIDGES IN ILLINOIS". This policy replaces the sections of Letter #91-8 entitled "Scour Evaluation for Existing Bridges" and "Scour Evaluation for New Bridges".

* This policy was updated by CL 93-12.

All existing bridges were to have been screened into one of three groups according to potential for scour problems as directed by Letter #91-8. A list of bridges delinquent for the Phase 1 scour screening is being furnished to the District Local Roads and Streets offices and will in turn be forwarded to each affected agency within two weeks.

The analysis/assessment phase of the scour evaluation program should now be commenced in accordance with the priorities established by the scour screening. The timetable for completion is included in Section 2.a. of the attached policy.

Questions concerning bridge scour evaluation and design may be directed to Tim Souther, Local Bridge Unit, phone (217)785-8748.

Very truly yours,

Bill Sunley

William T. Sunley, P.E.
Engineer of Local Roads and Streets

cc-
District Engineers

U.S. Department of Transportation
Federal Highway Administration

TECHNICAL ADVISORY

EVALUATING SCOUR AT BRIDGES

T 5140.23
October 28, 1991

Par.

1. PURPOSE. To provide guidance on developing and implementing a scour evaluation program for:

    a. designing new bridges to resist damage resulting from scour;

    b. evaluating existing bridges for vulnerability to scour;

    c. using scour countermeasures; and

    d. improving the state-of-practice of estimating scour at bridges.

2. CANCELLATION. Technical Advisory T 5140.20, Scour at Bridges, dated September 16, 1988, is cancelled.

3. BACKGROUND.

    a. The need to minimize future flood damage to the Nation's bridges requires that additional attention be devoted to developing and implementing improved procedures for designing, protecting and inspecting bridges for scour. (See National Bridge Inspection Standards, 23 CFR 650 Subpart C.) Current information on this subject has been assembled in the Federal Highway Administration (FHWA) design publication Hydraulic Engineering Circular (HEC) 18, "Evaluating Scour at Bridges," FHWA-IP-90-017.

    b. Paragraph 4 contains the FHWA recommendations for developing and implementing a scour evaluation program. The recommendations have been developed based on the review and evaluation of the existing policies and guidance pertaining to bridge scour set forth in paragraph 5.

The procedures in HEC 18 provide approaches for implementing these recommendations.

4. RECOMMENDATIONS FOR DEVELOPING AND IMPLEMENTING A SCOUR EVALUATION PROGRAM. Every bridge over a waterway, whether existing or under design, should be evaluated as to its vulnerability to scour in order to determine the prudent measures to be taken for its protection. Most waterways can be expected to experience scour over a bridge's service life (which could approach 100 years). Exceptions might include waterways in massive, competent rock formations where scour and erosion occur on a scale that is measured in centuries. (See HEC 18, Chapter 2.) The added cost of making a bridge less to scour is small when compared to the total cost of a failure which can easily be two or three times the original cost of the bridge. Moreover, the need to ensure public safety and to minimize the adverse effects stemming from bridge closures requires the best effort to improve the state-of-practice of designing and maintaining bridge foundations to resist the effects of scour. The recommendations listed below summarize the essential elements which should be addressed in developing a program for evaluating bridges and providing countermeasures for scour. Detailed guidance regarding approaches for implementing the recommendations is included in HEC 18.

   a. Interdisciplinary Team. Scour evaluations of new and existing bridges should be conducted by an interdisciplinary team comprised of hydraulic,geotechnical and structural engineers. (See HEC 18, Chapters 3 and 5.)

   b. New Bridges. Bridges over tidal and non-tidal waterways with scourable beds should withstand the effects of scour from a superflood (a flood exceeding the 100-year flood) without failing; i.e., experiencing foundation movement of a magnitude that requires corrective action.

      (1) Hydraulic studies should be prepared for bridges over waterways in accordance with Article 1.3.2 of the Standard Specifications for Highway Bridges of the American Association of State Highway and Transportation Officials (AASHTO) and the floodplain regulation of the FHWA as set forth in 23 CFR 650, Subpart A.

      (2) Hydraulic studies should include estimates of scour at bridge piers and evaluation of abutment stability. Bridge foundations should be designed to withstand the effects of scour without failing for the worst conditions resulting from floods equal to or less than the 100-year flood. (See HEC 18, Chapters 3 and 4.) Bridge foundations should be checked to ensure that they will not fail due to scour resulting from the occurrence of a superflood on the order of magnitude of a 500-year flood. (See HEC 18,Chapter 3.)

      (3) The geotechnical analysis of bridge foundations should be performed on the basis that all stream bed material in the scour prism above the total scour line for the design flood (for scour) has been removed and is not available for bearing or lateral support. In addition, the ratio of ultimate to applied loads should be greater than 1.0 for conditions of scour for the superflood. (See HEC 18, Chapter 3.)

      (4) Data on scour at bridge piers and abutments should be collected and analyzed in order to improve existing procedures for estimating scour. (See HEC 18, Chapter 1.)

   c. Existing Bridges. All existing bridges over tidal and non-tidal waterways should be evaluated for the risk of failure from scour during the occurrence of a superflood on the order of magnitude of a 500-year flood. (See HEC 18, Chapter 5.)

      (1) An initial screening process should identify bridges susceptible to scour and establish a priority list for evaluation. (See HEC 18, Chapter 5.)

      (2) Bridge scour evaluations should be conducted for each bridge to determine whether it is scour critical. A scour critical bridge is one with abutment or pier foundations which are rated as unstable due to:

         (a) observed scour at the bridge site or

(b) a scour potential as determined from a scour evaluation study. (See HEC 18, Chapter 5.)

(3) The procedures in Chapter 5 of HEC 18 should be followed in conducting and documenting the results of scour evaluation studies

d. Scour Critical Existing Bridges. A plan of action should be developed for each existing bridge determined to be scour critical. (See HEC 18, Chapter 5.)

(1) The plan of action should include instructions regarding the type and frequency of inspections to be made at the bridge, particularly in regard to monitoring the performance and closing of the bridge, if necessary, during and after flood events. (See HEC 18, Chapter 7.)

(2) The plan of action should include a schedule for the timely design and construction of scour countermeasures determined to be needed for the protection of the bridge. (See HEC 18, Chapter 7.)

e. Bridge Inspectors. Bridge inspectors should receive appropriate training and instruction in inspecting bridges for scour. (See HEC 18, Chapter 6.)

(1) The bridge inspector should accurately record the present condition of the bridge and the stream. At least one cross section at each bridge should be documented and compared with previously recorded cross section(s) at the site. Pier locations and footing elevations should be included.

(2) The bridge inspector should identify conditions that are indicative of potential problems with scour and stream stability.

(3) Effective notification procedures should be available to permit the inspector to promptly communicate findings of actual or potential scour problems toothers for further review and evaluation.

(4) Special attention should be focused on the routine inspection of scour critical bridges and on the monitoring and closing as necessary of scour critical and other bridges during and after floods.

5. EXISTING POLICY AND GUIDANCE. The following existing policy and guidance serve as the basis for the recommendations set forth in paragraph 4.

a. AASHTO Standard Specifications for Highway Bridges. The FHWA has accepted these specifications for the design of highway bridges. The 1991 Interim Specifications contain requirements for designing bridges to resist scour. Particular attention is directed to Article 1.3.2, Hydraulic Studies, which advises that, "Hydraulic studies . . . should include applicable parts of the following outline:" Included in this outline is item 1.3.2.3 (b), Estimated scour depth at piers and abutments of proposed structures.

b. AASHTO Manual for Bridge Maintenance. The FHWA endorses the guidance contained in this 1987 Manual for Bridge Maintenance. Particular attention is directed to the following two statements support the recommendations contained in this Technical Advisory:

(1) "The primary function of the bridge maintenance program is to maintain the bridges in a condition that will provide for safe and uninterrupted traffic flows. The protection of the investment in the structure facility through well programmed repairs is second only to the safety of traffic and to the structure itself." (p. 25.)

(2) "Determining an effective solution to a stream bed or river problem is difficult. Settlement of foundations, local scour, bank erosion, and channel degradation are complex problems

and cannot be solved by one or two prescribed methods. Hydraulic, geotechnical, and structural engineers are all needed for consultation prior to undertaking the solution of a serious maintenance problem. In some cases, certainremedial work could actually be detrimental to the structure." (p. 155.)

c. AASHTO Manual for Maintenance Inspection of Bridges.The FHWA endorses the guidance provided in the current version of this manual which serves as a standard and provides uniformity in the procedures and policies in determining the physical condition and maintenance needs of bridges. The manual emphasizes the importance of documenting and comparing cross sections taken upstream of bridges over time to discern potential scour problems.

d. Code of Federal Regulations, 23 CFR 650, Subpart C. The 1989 revision of this FHWA regulation on the National Bridge Inspection Standards requires that bridge owners maintain a bridge inspection program that includes procedures for underwater inspection. This Technical Advisory and HEC 18 provide guidance on the development and implementation of procedures for evaluating bridge scour to meet the requirements of the regulation.

e. Memorandum From the Director, Office of Engineering, to Regional Federal Highway Administrators and Direct Federal Program Administrator Dated April 17, 1987. This memorandum stated in part, "Each State should evaluate the risk of its bridges being subjected to scour damage during floods on the order of a 100 to 500 year return period or more."

f. FY 1991 High Priority Research Program of the FHWA. The FHWA recognizes the subject of scour at bridges as a long range high priority national program area for research and recommends that appropriate studies be carried out to improve the state-of-practice of designing new bridges and evaluating existing bridges for scour.

Thomas O. Willett, Director
Office of Engineering
